Acute otitis media in children presenting to the emergency department: Is it diagnosed and managed appropriately?

Balasundaram, Niroshan; Phan, Dung; Mazzoni, Daniel; Duong, Elliot; Sweeny, Amy; Del Mar, Chris; Keijzers, Gerben

Published in:
Journal of Paediatrics and Child Health

DOI:
10.1111/jpc.14414

Abstract

Objectives

To describe the diagnostic and management practice in children with acute otitis media (AOM) presenting to the emergency department (ED), and compare diagnosis and management against existing guidelines.

Materials and Methods

We performed a retrospective descriptive cohort study of patients ≤15 years of age, who presented to two EDs in Southeast Queensland between January 2016 and June 2017 with an ED diagnosis of AOM. Likelihood of diagnosis was based on medical records and classified as likely, possible or unlikely, using paediatric practice guidelines. Appropriateness of antibiotics prescription was classified by using the National Antibiotic Prescribing Survey (NAPS), which takes into account adherence to the Australian Therapeutic Guidelines (eTG). Each medical record was extracted by two blinded reviewers, and discrepancies resolved by consensus or arbitration.

Results

Of the 305 patients available for analysis, 87% had a likely or possible diagnosis of AOM. Otalgia was the presenting complaint in 75%. Standard otoscopy was the routine method for tympanic membrane visualisation and 70% had abnormal tympanic membrane findings. Almost two-thirds (62%) of all children were prescribed antibiotics. Antibiotic appropriateness could be ascertained for 286 patients(94%). Thirty-nine percent received inappropriate antibiotic management for AOM. The majority of patients received analgesia in the form of paracetamol and/or ibuprofen.

Conclusion

ED clinicians make the diagnosis of AOM fairly accurately, although better assessment of the tympanic membrane by tympanometry and/or pneumatic otoscopy may improve accuracy. More than one-third of patients are prescribed antibiotics inappropriately. Our data can inform knowledge translation and education strategies to ensure the correct evidence-based management of this condition.

Keywords: Acute Otitis Media, Antibiotics, Emergency Department, Paediatrics

What is already known on this topic

- Acute otitis media (AOM) is a common condition in infancy and childhood and a common diagnosis made in the emergency department
- AOM often resolves without medical intervention
- Inappropriate prescribing is associated with adverse drug reactions and antimicrobial resistance

What this paper adds

- This paper quantifies current practice and describes evidence-practice gaps for both diagnosis and treatment in children with an ED diagnosis of AOM
- The majority of children were prescribed antibiotics, of which more than one-third was inappropriate.
- This data can inform knowledge translation and education strategies to ensure appropriate management of AOM

Introduction

Acute otitis media (AOM) is a common condition in infancy and childhood. Although most commonly this is a benign condition, AOM is associated with sequelae such as otorrhea, perforation of the tympanic membrane, chronic suppurative otitis media and rarely, mastoiditis.[1] Episodes of AOM are associated with fluctuating mild-moderate conductive hearing loss, leading to potential deficits in language and developmental delay.[2,3.]

Pain and fever are common features leading to emergency department (ED) presentations. There is no gold standard for the diagnosis of AOM. Symptoms and signs used to diagnose AOM include pain, tympanic membrane bulging and fever, and confirmation of middle ear effusion is considered critical to diagnostic accuracy.[5] However, the diagnosis of AOM can be challenging to make, especially when neonates or infants present with non-specific signs or symptoms, or when the tympanic membrane is difficult to visualise. Although there is no universally accepted algorithm to diagnose AOM, several guidelines exist such as the guidelines from the Royal Melbourne Children's Hospital[6], the American Academy of Paediatrics guidelines[7] and the Dutch general practice guidelines[8]. Despite this array of guidelines that can be utilised in making a diagnosis and aiding management, these need to be interpreted using the principles of evidence-based medicine and include clinical judgment.[7]

AOM can be viral, bacterial or combined viral-bacterial in nature and regardless of aetiology often resolves without medical intervention.[9] Nevertheless, many (primary care and ED) clinicians often prescribe antibiotics for a patient with a working diagnosis of AOM. Concerns about inappropriate prescribing are fuelled by the emerging antimicrobial resistance crisis, and strategies to avoid unnecessary prescribing are needed. Some clinicians aim to avoid antibiotic use by utilising a prescribe and 'watch-and-wait' strategy, whereby an antibiotic prescription is provided with the advice to parents or carers to fill it if symptoms have not spontaneously improved within a set timeframe, usually 48 hrs.[10] Variations in guidelines likely lead to practice variation in the decision to prescribe antibiotics, including type and duration.

Little is known about current diagnostic and management practices in children who present to the ED and receive a diagnosis of AOM. We aimed to describe and quantify current practice and elucidate evidence-practice gaps (or guideline-practice gaps) for both diagnosis and treatment, in children with an ED diagnosis of AOM.

Materials and Methods

Study design

We conducted a retrospective, descriptive cohort study of consecutive paediatric patients with an ED diagnosis of AOM. Ethics approval was received from the Gold Coast Hospital Health Service (GCHHS) Human Research and Ethics Committee. The study reporting adheres to the STROBE statement.[11]

Study setting and population

We included all children up to 15 years of age who had a primary ED Information system (EDIS) diagnosis of AOM (ICD-10 AM code H66.9) over an 18-month period (1 January 2016- 1 July 2017) at two hospitals: Gold Coast University Hospital (GCUH), a tertiary facility with a dedicated children's ED, which overall had 107,000 attendance in 2017, of which 22% were paediatric (aged under 15 years), and Robina Hospital, a general hospital with a mixed ED with 61,000 attendances in 2017 of which 16% were paediatric. Both EDs have standard otoscopes at all designated cubicles or beds, allowing direct otoscopy.

Data extraction

We extracted information on the following pre-specified data from the electronic medical record (eMR) using a data collection sheet: the Australasian Triage Scale (ATS); mode of arrival; presenting complaint; seniority of the doctor who made the diagnosis; patient demographics, clinical features; management; and disposition (whether admitted, and any referral to Ears, Nose and Throat [ENT] specialists). Two authors (any combination of NB, DM, DP and ED) extracted data independently for each patient, resolving discrepancies by consensus, or failing that, submitting the case to arbitration by a senior clinician (GK).

Classification

The diagnostic accuracy of AOM was classified according to existing guidelines[6-8] into three categories; likely, possible and unlikely (see Box 1). This classification was formulated by drawing on several available paediatric practice guidelines, including extracts from the Dutch general practice guidelines[6], the American Academy of Paediatrics[7] and the Royal Melbourne Children's Hospital[8]. The treating doctor's clinical assessment of the child's signs and symptoms, as documented in medical notes, was used to determine the likelihood category. Any patient who was deemed to have an alternative diagnosis was excluded from the analysis.

The appropriateness of antimicrobial management was assessed using the National Antibiotic Prescribing Survey (NAPS)[12], which takes into account adherence to the Australian Therapeutic Guidelines (eTG, v15)[13]. Assessment of appropriateness was made assuming that a correct diagnosis of AOM was made. According to the eTG, all of the following conditions would be appropriate reasons for antibiotic treatment; presence of systemic features including vomiting, high-grade fever (≥39.4^{0}C) or lethargy; children under 6 months of age without any systemic features, but presence of discharge or bilateral AOM; background of Aboriginal or Torres Strait Islander; or AOM with symptoms persisting or worsening after two days. The level of appropriateness of antibiotic therapy was classified using four categories; optimal, adequate, suboptimal and inappropriate (see Box 2). For analysis, optimal and adequate were classed as 'appropriate' and suboptimal and inappropriate were both classed as 'inappropriate'. Specific details such as choice of antibiotic prescribed, dosage, route and duration, were all assessed before classification was made. Besides antibiotic appropriateness, whether or not pain relief was documented/given was considered. Symptomatic treatment is recommended for all cases of AOM.

Data analysis

Data are reported using descriptive statistics including proportions. Differences in diagnostic likelihood or antibiotic appropriateness proportions by patient characteristics were tested using the chi-square test or Fisher's Exact Test for small

cells, or the chi-square test for trend, where indicated. A p-value <.05 was considered statistically significant.

Results

A total of 323 patients with an EDIS diagnosis of AOM were identified during the study period. Twelve were excluded for further analysis since they had a clear alternative diagnosis. An additional six children were excluded due to a lack of clinical notes recorded in the eMR (Figure 1). Overall, 305 patients were available for analysis, of which 58% were male and 25% (n=78) were under 2 years of age. The median age was 4 years [IQR 1.6-7.0]. Forty-three children (14%) had prior ENT conditions (e.g. ventilation tubes [grommets]) with four having documented cranio-facial co-morbidities.

Diagnosis

Of the 305 patients included, 27% (n=82) of patients met the criteria for a likely diagnosis of AOM, and 60% (n=183) had a possible diagnosis of AOM. About one in eight (13%, n=40) were classified as unlikely having a diagnosis if AOM.

Table 1 describes diagnostic accuracy of AOM by clinical and process variables. Otalgia was the most common presenting complaint (75%, n=228). Seventy percent of patients had tympanic membrane findings, including redness (50%), bulging (23%) and effusions or air-fluid levels (21% combined). The remaining 30% had no abnormal tympanic membrane assessment documented either due to normal otoscopy or inability to assess the tympanic membrane. Abnormal tympanic membrane findings were more common in likely or possible AOM (Table 1). Twelve of 40 patients in whom AOM was unlikely had otorrhoea as the primary presenting complaint. The majority of patients (89%) with previous episodes of AOM had either a likely or possible diagnosis of AOM. Fever $\geq$ 38.0°C was present in 21% of presentations and was significantly associated with a likely or possible diagnosis of AOM with only 9.5% of febrile children deemed unlikely to have AOM compared with 14.0% of non-febrile children(p<.001). Pain relief was also more likely to be

administered for children meeting criteria for likely or possible AOM compared to those deemed unlikely to have AOM (90.5% vs 80.2%; p=0.002).

Registrar-level doctors diagnosed and managed over half (n=171, 56%) of the study population. We found no significant difference in diagnostic accuracy by seniority of the diagnosing doctor, which ranged from 76-93%.

Management

When compared against Australian therapeutic guidelines using the NAPS definitions of appropriateness, antibiotic management was considered optimal in 43%, adequate in 17%, suboptimal in 1%, and inappropriate in 39% (Figure 1). In 6% of patients, it was not possible to ascertain appropriateness of management. AOM management was more likely to be appropriate (optimal or adequate) when the child; had a fever, attended the general regional hospital, received pain relief, had a diagnosis that was likely, and did not receive antibiotics (Table 2).

Almost two-thirds (62%, n=189) of children in this study were prescribed antibiotics, including half of those deemed unlikely to have AOM. Appropriateness could not be ascertained for nine of the 189 children; of the remaining 180 children, 47% received inappropriate antibiotics. Nearly all the inappropriate prescriptions were for children where antibiotics were not recommended by eTG. For the patients who did not receive an antibiotic prescription, 72% (n=76/105) were appropriately managed, as they did not meet antibiotic prescription criteria.

The most frequently prescribed antibiotic was amoxicillin (63%), and amoxicillin/clavulanic acid was inappropriately prescribed in over half of the times when it was prescribed (19/34). The duration of antibiotic therapy was most commonly 5 days (59.3%), or 7 days (13.2%) (data not shown), with universally correct dosing. Twenty-three were given a prescription for an antibiotic and advised not to take them unless the child deteriorated (watch-and-wait).

For analgesia and supportive care, ibuprofen and paracetamol were the most frequently prescribed (46.3% and 45.6% respectively). Opioids were prescribed in

6.5% (n=20) of patients and topical local anaesthetic agents were rarely used (0.3%). Children who received opioids were more likely to; have had prior AOM (45% vs 18%); have an effusion on otoscopy (30% vs 15%) and; be admitted to a ward (10% vs 1.1%) compared to children who received simple analgesia (n=179). About one-third of children received a combination of analgesic medications.

The median ED length of stay was 2.2 hrs [IQR 1.4-3.1], and 276 (90.5%) of children were assessed and managed within 4 hours. Length of stay was not associated with either likelihood of diagnosis or management appropriateness. Almost all children (92.5%, n=283) were discharged home, 5.9% (n=18) were admitted to the ED short-stay unit, and 1% (n=3) were admitted to the paediatric ward. One patient was transferred out and disposition for one child was unknown. The representation rate within one-week was 4.9% and this was not associated with likelihood of diagnosis or appropriateness of antibiotics (Tables 1 and 2).

Discussion

This study evaluated diagnostic and management practices for AOM in children diagnosed in the ED. The majority (87%) of patients had a likely or possible diagnosis of AOM, with only 1 in 8 having another diagnosis more likely. Based on the diagnostic criteria used, ED clinicians have a fair to good accuracy in making the diagnosis. An inappropriate diagnosis may invariably lead to inappropriate treatment and management.

Over one-third (39%) of patients with a discharge diagnosis of AOM received inappropriate antibiotic management according to the NAPS classification using therapeutic guidelines. This proportion was the same if patients with an unlikely diagnosis of OAM were not taken into consideration. This high proportion of inappropriate management may reflect a potential knowledge gap, lack of experience by clinicians when dealing with such a condition, or other unmeasured variables such as (perceived) patient or parent expectation. In addition, this could also stem from a lack of understanding or utilization of guidelines by clinicians in the

ED setting. Quach et al,[14] published a retrospective analysis of physician prescribing patterns in relation to AOM. Consistent, albeit somewhat higher, they found that 47% of prescriptions given by physicians in the emergency settings were not conform with consensus guidelines.

A 2015 Cochrane review[15] concluded that antibiotics have a limited role in the treatment of AOM in children (aged 2 months to 15 years). It emphasized that management should be focused on adequate analgesia. It further states that in high income countries, most cases of AOM spontaneously remit without complications, since many episodes of AOM are viral in etiology. In our study, almost half of antibiotic therapies were found to be inappropriate or unnecessary, suggesting there is ample room for improvement. The possible harms of antibiotic use are well known and include common patient-level adverse drug reactions including vomiting, diarrhoea and allergic reactions. These adverse events occur in one in every fourteen children given antibiotics.[15] Antimicrobial resistance and health economic consequences are important at population level.[16] It may be appropriate to treat AOM on a "watch-and-wait basis" in non-severe cases by withholding antibiotics, but antibiotics are encouraged to be initiated if the child's condition worsens or fails to improve within 24 to 48 hours.[17] In our study this "watch-and-wait basis" approach was applied in only 7.5% of patients, suggesting this approach could be considered more frequently. Individual EDs may consider selected review of patients to encourage this approach, depending on local resources and access to alternative follow up (eg. General Practitioner).

When antibiotics are indicated, the correct antibiotic choice and duration are also important aspects of appropriate management. The most commonly used antibiotic in our two study EDs was amoxicillin (63%) and the duration of antibiotic use was most commonly 5 days (59%), which is consistent with Australian guidelines (eTG). Although the 5-day duration is considered standard treatment in Australia, there is ongoing debate regarding the optimal duration of treatment, with 5 days referred to as a shortened or reduced duration of treatment in the US.[18]

Despite this, antibiotics should be withheld in many circumstances, and appropriate pain relief management is considered the cornerstone of management in these

cases of AOM.[17] Therapeutic guidelines recommend prescribing pain relief as appropriate for all cases. In this study, one-third of children with likely or possible AOM did not have pain relief prescription documented during their ED stay. However, it is possible that the child was being adequately managed for pain at home, parents declined analgesia, or this proportion could be a reflection of suboptimal documentation. Furthermore, 20 children received opioid analgesia. This was not the first analgesic given and children received paracetamol and/or ibuprofen prior to the opioid (prior to ED arrival or in ED). Further investigation into pain management practices, including paediatric opioid stewardship, may be warranted.

Limitations

This study suffers from inherent limitations of retrospective design. However clinical records and documentation were complete and sufficient for diagnostic assessment in more than 98% of cases, and for appropriateness of management in 94%, although we cannot comment on accuracy or omissions of documentation. Furthermore, our study is prone to limitations of medical record review, but we aimed to negate this bias by using two independent data extractors using a pre-formatted data collection form for each patient. Patients with AOM were selected based on the ED diagnosis, and we recognize that there are potentially missed patients with AOM who received a different diagnosis. This may have affected our accuracy of diagnosis findings but would have had little impact on our appropriateness of management findings. Visualising the tympanic membrane is important to confirm the diagnosis and was conducted with direct otoscopy in this study, reflecting the practice in our study setting. Pneumatic otoscopy provides a dynamic assessment of tympanic membrane mobility via changes in pressure, and we acknowledge that our diagnostic accuracy data may have been improved if a pneumatic otoscope or tympanometry were used for diagnosis.[19] Furthermore, in absence of a gold standard for OAM, our chosen diagnostic criteria focused on symptoms moreso than signs, possibly leading to a lower threshold for making the diagnosis in symptomatic children.

Finally, there is possibly an over-estimation of appropriate management of patients. Therapeutic guidelines do support antibiotics for children with systemic features and consistent with this, we interpreted prescription of antibiotics as 'appropriate' for children who had a documented fever or (transient) vomiting. Ideally, such scenarios would lead to a shared-decision making decision where depending on parental expectation and clinician experience a variation of choices including conservative management can be discussed.

Conclusion

ED clinicians diagnose AOM with fair to good accuracy based on the criteria used, although improved assessment of tympanic membranes by either tympanic otoscopy or tympanometry may improve accuracy further. We identified evidence-practice gaps in antibiotic prescribing, highlighting a significant proportion of children with AOM diagnosed in the ED receiving inappropriate antibiotics. Our data can inform knowledge translation, with a focus on watch-and-wait strategies and education strategies, focusing. Such initiatives are required to ensure the correct evidence-based management of this condition, ultimately improving clinical and health-economic outcomes.

References

1. Abbott P, Gunasekera H, Leach AJ, et al. A multi-centre open-label randomised noninferiority trial comparing watchful waiting to antibiotic treatment for acute otitis media without perforation in low-risk urban Aboriginal and Torres Strait Islander children (the WATCH trial): study protocol for a randomised controlled trial.*Trials* 2016;17:119.
2. Williams CJ, Jacobs AM. The impact of otitis media on cognitive and educational outcomes. *Med J Aust* 2009;191(9 Suppl):S69.
3. Sibthorpe B, Agostino J, Coates H, Weeks S, Lehmann D, Wood M, et al. Indicators for continuous quality improvement for otitis media in primary health care for Aboriginal and Torres Strait Islander children. *Aus J Prim Health* 2017;23(1):1-9.
4. Abbott P, Rosenkranz S, Hu W, Gunasekera H, & Reath J. The effect and acceptability of tympanometry and pneumatic otoscopy in general practitioner diagnosis and management of childhood ear disease. *BMC Family Practice* 2014; **15**(181). doi: 10.1186/s12875-014-0181-x.
5. Coker TR, Chan LS, Newberry SJ, Limbos MA, Suttorp MJ, Shekelle PG, Takata GS. Diagnosis, microbial epidemiology, and antibiotic treatment of acute otitis media in children: a systematic review. *JAMA*. 2010;**304**(19):2161-9. doi: 10.1001/jama.2010.1651. Review.
6. Acute otitis media. The Royal Children's Hospital Melbourne Web Site. https://www.rch.org.au/clinicalguide/guideline_index/Acute_otitis_media/. Updated 2017. Accessed November 25, 2017.
7. Diagnosis and management of acute otitis media. *Paediatrics* 2004;113(5):1451-1465.
8. Damoiseaux RAMJ, Venekamp RP, Eekhof JAH, et al. NHG Guidelines for General Practitioners. Utrecht, Netherlands: Bon Stafleu Van Loghum; 2014
9. Nokso-Koivisto J, Marom T, Chonmaitree T. Importance of Viruses in Acute Otitis Media. *Curr Opin Pediatr* 2015;27(1):110-115.
10. Isaacs D. Duration of antibiotics for acute otitis media in under 2 year olds. *J Paediatr Child Health* 2017;53(5):513-514.
11. STROBE statement checklist for cohort studies. STROBE statement Web Site. https://www.strobe-statement.org/index.php?id=available-checklists. Updated 2009. Accessed January 4, 2018.
12. Acute otitis media. National Antimicrobial Prescribing Survey Web site. https://www.naps.org.au. Updated 2017. Accessed on January 9, 2018.
13. Therapeutic Guidelines. Available from URL: https://www.tg.org.au Accessed on August 25, 2018.
14. Quach C, Collet JP, LeLorier J. Acute Otitis Media in children: a retrospective analysis of physician prescribing patterns. *Br J Clin Pharmacol*. 2004;57(4):500-505.
15. Venekamp RP, Sanders SL, Glasziou PP, Del Mar CB, Rovers MM. Antibiotics for acute otitis media in children. Cochrane Database System Rev [Internet]. 2015 [cited 2017 Nov 13]. Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD000219.pub4/full.
16. Friedman ND, Temkin E, Carmeli Y. The negative impact of antibiotic resistance. *Clin Microbiol Infect*. 2016;22(5):416-22.

17. Le Saux N, Robinson JL; Canadian Paediatric Society, Infectious Diseases and Immunisation Committee. Management of acute otitis media in children six months of age and older. *Paediatr Child Health* 2016; 21(1):39-44.
18. Hoberman A, Paradise JL, Rockette HE, Kearney DH, Bhatnagar S, Shope TR, et al. Shortened Antimicrobial Treatment for Acute Otitis Media in Young Children. *N Engl J Med* 2016;375(25):2446-2456.
19. Takata GS, Chan LS, Morphew T, Mangione-Smith R, Morton SC, Shekelle P. Evidence assessment of the accuracy of methods of diagnosing middle ear effusion in children with otitis media with effusion. *Pediatrics.* 2003;112(6 Pt 1):1379-87. Review.

Box 1: Classification criteria for diagnosing AOM[5,6,7]

Classification
Likely: a) otalgia *AND* b) fever/unwell *AND* c) *at least one* tympanic membrane abnormality (e.g. bulging/red/retracted/effusion) **Possible:** a) otalgia *AND* b) fever/unwell *OR* c) *at least one* tympanic membrane abnormality **Unlikely:** a) **absence of otalgia *OR*** b) **otalgia with absence of both i) fever/unwell AND ii) tympanic membrane abnormality**

Box 2: Classification criteria for AOM antibiotic management appropriateness as per NAPS guidelines[11]

Classification	
Appropriate	**Optimal** Optimal antimicrobial choice/dosage/route/duration
	Adequate Non-optimal choice/dosage/route/duration, but is a reasonable alternative for the likely causative pathogen
Inappropriate	**Suboptimal** Unreasonable choice/dosage/route/duration including: a) Spectrum excessively broad or an unnecessary overlap in spectrum of activity b) Mild or non-life-threatening allergy mismatch
	Inappropriate Antimicrobial choice/dosage/route/duration is not indicated to treat the likely causative pathogen *OR* An anti-microbial is not indicated for the presumed infection *OR* There may be a severe or possible life-threatening allergy mismatch
Not able to be assessed	The notes are not comprehensive enough to assess appropriateness, or The patient is too complex, due to multiple co-morbidities, allergies or microbiology results

Table 1. Patient and hospital characteristics by likelihood of diagnosis for acute otitis media, amongst children <15 years who had an emergency department diagnosis of acute otitis media

	Likely (n=82)		Possible (n=183)		Unlikely (n=40)		Overall (n=305)	
	n	%	n	%	n	%	n	%
Age								
<6mos	1	8.3	8	66.7	3	25.0	12	3.9
6mos-23mos	20	30.3	29	43.9	17	25.8	66	21.6
24+mos	61	26.9	146	64.3	20	8.8	227	74.4
Sex								
M	51	28.7	104	58.4	23	12.9	178	58.4
F	31	24.4	79	62.2	17	13.4	127	41.6
AOM symptoms present								
Otalgia	76	33.3	145	63.6	7	3.1	228	74.8
No otalgia documented	6	7.8	38	49.4	33	42.9	77	25.2
Otorrhoea	19	22.9	52	62.7	12	14.5	83	27.2
No otorrhoea documented	63	28.4	131	59.0	28	12.6	222	72.8
Fever >=38°C	38	60.3	19	30.2	6	9.5	63	20.7
No fever documented	44	18.2	164	67.8	34	14.0	242	79.3
Any two or more of otalgia, fever or otorrhea	43	46.7	47	51.1	2	2.2	92	30.2
Only one of: otalgia, fever, otorrhea	37	20.6	122	67.8	21	11.7	180	59.0
None of above	2	6.1	14	42.4	17	51.5	33	10.8
Systemic features present								
Systemic† and one or more symptoms	15	25.9	37	63.8	6	10.3	58	19.0
Systemic† but no symptoms	0	0.0	3	33.3	6	66.7	9	3.0
Not systemic but one or more symptoms	65	30.4	132	61.7	17	7.9	214	70.2

Neither systemic nor symptoms present	2	8.3	11	45.8	11	45.8	24	7.9
Tympanic membrane features								
Redness	58	38.2	83	54.6	11	7.2	152	49.8
Bulging	30	42.3	37	52.1	4	5.6	71	23.3
Ruptured	8	24.2	22	66.7	3	9.1	33	10.8
Abnormal air fluid level	4	36.4	7	63.6	0	0.0	11	3.6
Effusion	18	33.3	30	55.6	6	11.1	54	17.7
Any of above	74	34.7	121	56.8	18	8.5	213	69.8
Any of above, except redness	49	37.1	73	55.3	10	7.6	132	43.3
Triage category								
2	1	12.5	4	50.0	3	37.5	8	2.6
3	58	28.2	114	55.3	34	16.5	206	67.5
4/5	23	25.3	65	71.4	3	3.3	91	29.8
Previous acute otitis media								
Yes	21	30.4	40	58.0	8	11.6	69	22.6
No/Unknown	61	25.8	143	60.6	32	13.6	236	77.4
Treating doctor level								
Junior (intern or student)	5	13.2	25	65.8	8	21.1	38	12.5
Resident	29	31.2	58	62.4	6	6.5	93	30.5
Registrar	47	27.5	98	57.3	26	15.2	171	56.1
Consultant	7	24.1	15	51.7	7	24.1	29	9.5
Other/unknown	1	33.3	2	66.7	0	0.0	3	1.0
Hospital								
Robina	30	40.5	43	58.1	1	1.4	74	24.3
University Hospital	52	22.5	140	60.6	39	16.9	231	75.7
Watch and wait method used								
Yes	7	30.4	15	65.2	1	4.3	23	7.5
No	75	27.0	165	59.4	38	13.7	278	91.1

Not documented/unknown	0	0.0	3	75.0	1	25.0	4	1.3
Antibiotic use								
Yes	57	30.2	112	59.3	20	10.6	189	62.0
No	25	21.6	71	61.2	20	17.2	116	38.0
Analgesia use								
Paracetamol only	10	20.8	30	62.5	8	16.7	48	15.7
Ibuprofen only	21	40.4	29	55.8	2	3.8	52	17.0
Opioid only	0	0.0	6	100.0	0	0.0	6	2.0
Combination of above	31	33.3	53	57.0	9	9.7	93	30.5
Any pain relief	*62*	*31.2*	*118*	*59.3*	*19*	*9.5*	*199*	*65.2*
No pain relief	*20*	*18.9*	*65*	*61.3*	*21*	*19.8*	*106*	*34.8*
Represented within one week								
Yes	4	26.7	7	46.7	4	26.7	15	4.9
No	78	26.9	178	61.4	36	12.4	290	95.1
Exceeded 4 hours of stay								
Yes	72	26.1	168	60.9	36	13.0	276	90.5
No	10	34.5	15	51.7	4	13.8	29	9.5

†systemic: vomiting, fever ≥39.4, abdominal pain

Table 2. Appropriateness of antibiotic management in children <15 years of age diagnosed in the emergency department with acute otitis media

	Optimal/ adequate (n=172)		Suboptimal/ inappropriate (n=114)		Overall (n=286)†	
	n	%	n	%	n	%
Age						
<6mos	7	63.6	4	36.4	11	3.8
6mos-23mos	36	57.1	27	42.9	63	22.0
24+mos	129	60.8	83	39.2	212	74.1
Sex						
M	100	60.2	66	39.8	166	58.0
F	72	60.0	48	40.0	120	42.0
Symptoms present						
Otalgia	130	60.2	86	39.8	216	75.5
No otalgia documented	42	60.0	28	40.0	70	24.5
Otorrhoea	44	57.1	33	42.9	77	26.9
No otorrhoea documented	128	61.2	81	38.8	209	73.1
Fever >=38°C	45	80.4	11	19.6	56	19.6
No fever documented	127	55.2	103	44.8	230	80.4
Any two or more of otalgia, fever or otorrhea	53	63.9	30	36.1	83	29.0
Only one of: otalgia, fever, otorrhea	106	60.9	68	39.1	174	60.8
None of above	13	44.8	16	55.2	29	10.1
Systemic features present						
Systemic^ and one or more symptoms	38	70.4	16	29.6	54	18.9
Systemic^ but no symptoms	3	37.5	5	62.5	8	2.8
Not systemic but one or more symptoms	121	59.6	82	40.4	203	71.0

Neither systemic nor symptoms present	10	47.6	11	52.4	21	7.3
Tympanic membrane findings						
Redness	89	63.1	52	36.9	141	49.3
Bulging	40	59.7	27	40.3	67	23.4
Ruptured	16	53.3	14	46.7	30	10.5
Abnormal air fluid level	6	54.5	5	45.5	11	3.8
Effusion	29	58.0	21	42.0	50	17.5
Any of above	117	58.5	83	41.5	200	69.9
Any of above, except redness	70	56.5	54	43.5	124	43.4
Triage category						
2	6	85.7	1	14.3	7	2.4
3	121	62.7	72	37.3	193	67.5
4/5	45	52.3	41	47.7	86	30.1
Previous AOM						
Yes	38	56.7	29	43.3	67	23.4
No/Unknown	134	61.2	85	38.8	219	76.6
Treating doctor level						
Junior (intern or student)	21	61.8	13	38.2	34	11.9
Resident	59	66.3	30	33.7	89	31.1
Registrar	73	54.1	62	45.9	135	47.2
Consultant	17	68.0	8	32.0	25	8.7
Other/unknown	2	66.7	1	33.3	3	1.0
Hospital						
Robina	53	74.6	18	25.4	71	24.8
University Hospital	119	55.3	96	44.7	215	75.2
Watch and wait method used						
Yes	9	39.1	14	60.9	23	8.0
No	161	61.9	99	38.1	260	90.9
Unknown	2	66.7	1	33.3	3	1.0
Antibiotic use						

Yes	96	53.0	85	47.0	181	63.3
No	76	72.4	29	27.6	105	36.7
Analgesia use						
Paracetamol only	30	66.7	15	33.3	45	15.7
Ibuprofen only	29	59.2	20	40.8	49	17.1
Opioid only	3	50.0	3	50.0	6	2.1
Combination of above	63	71.6	25	28.4	88	30.8
Any pain relief	*125*	*66.5*	*63*	*33.5*	*188*	*65.7*
No pain relief	*47*	*48.0*	*51*	*52.0*	*98*	*34.3*
Likelihood of acute otitis media condition						
Likely	53	71.6	21	28.4	74	25.9
Possible	100	56.8	76	43.2	176	61.5
Unlikely	19	52.8	17	47.2	36	12.6
Represented within one week						
Yes	8	57.1	6	42.9	14	4.9
No	164	60.3	108	39.7	272	95.1
Exceeded 4 hours of stay						
Yes	21	72.4	8	27.6	29	10.1
No	151	54.7	106	38.4	257	89.9

† Excludes 19 patients for whom antibiotic appropriateness could not be ascertained

Figure 1: Flowchart of included patients and antibiotic prescription